

Aug. 23, 1938.

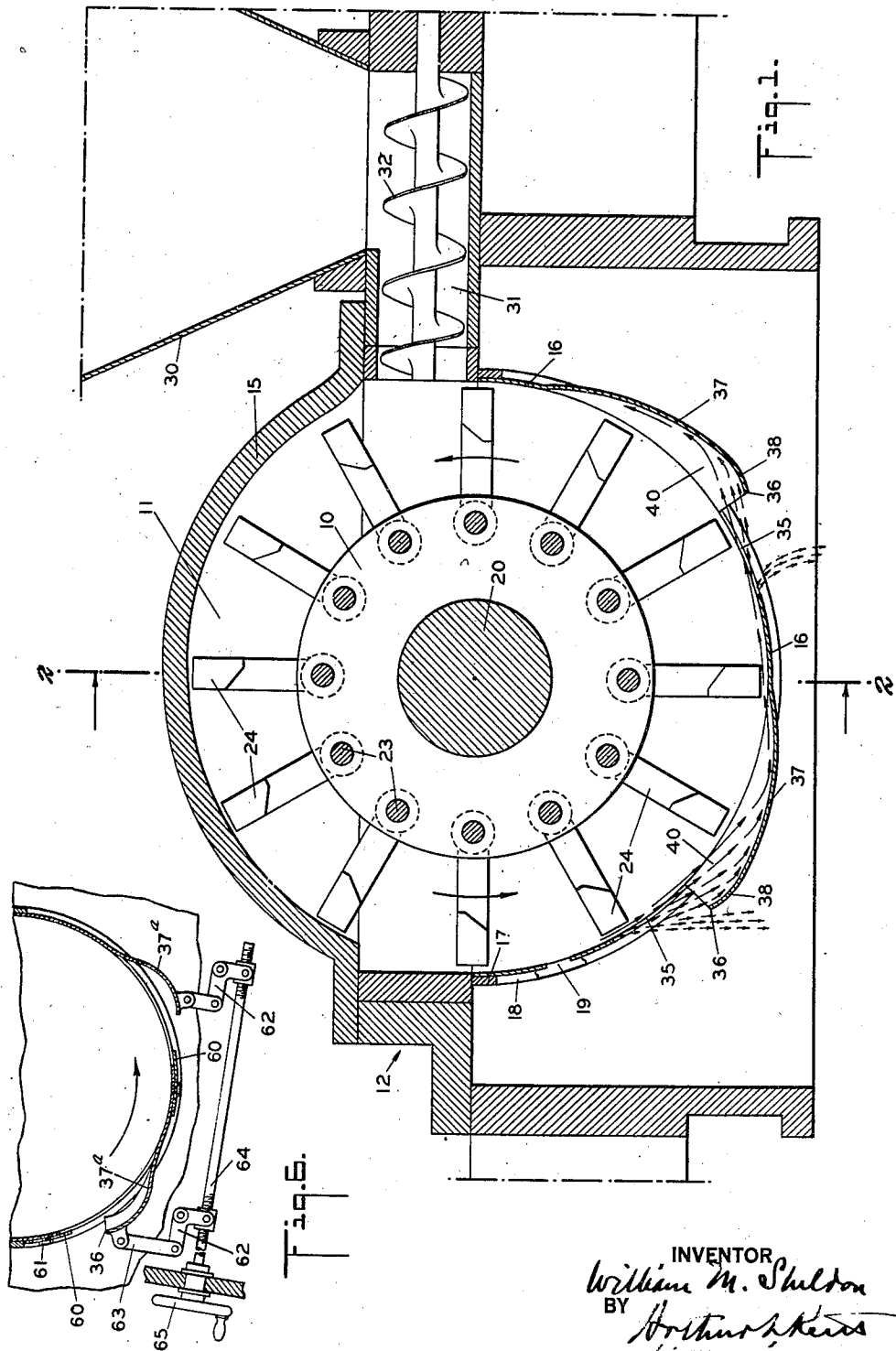
W. M. SHELDON

2,128,194

REDUCING MILL

Filed June 12, 1935

2 Sheets-Sheet 1



INVENTOR
William M. Sheldon
BY
Arthur S. Keene
his ATTORNEY

Aug. 23, 1938.

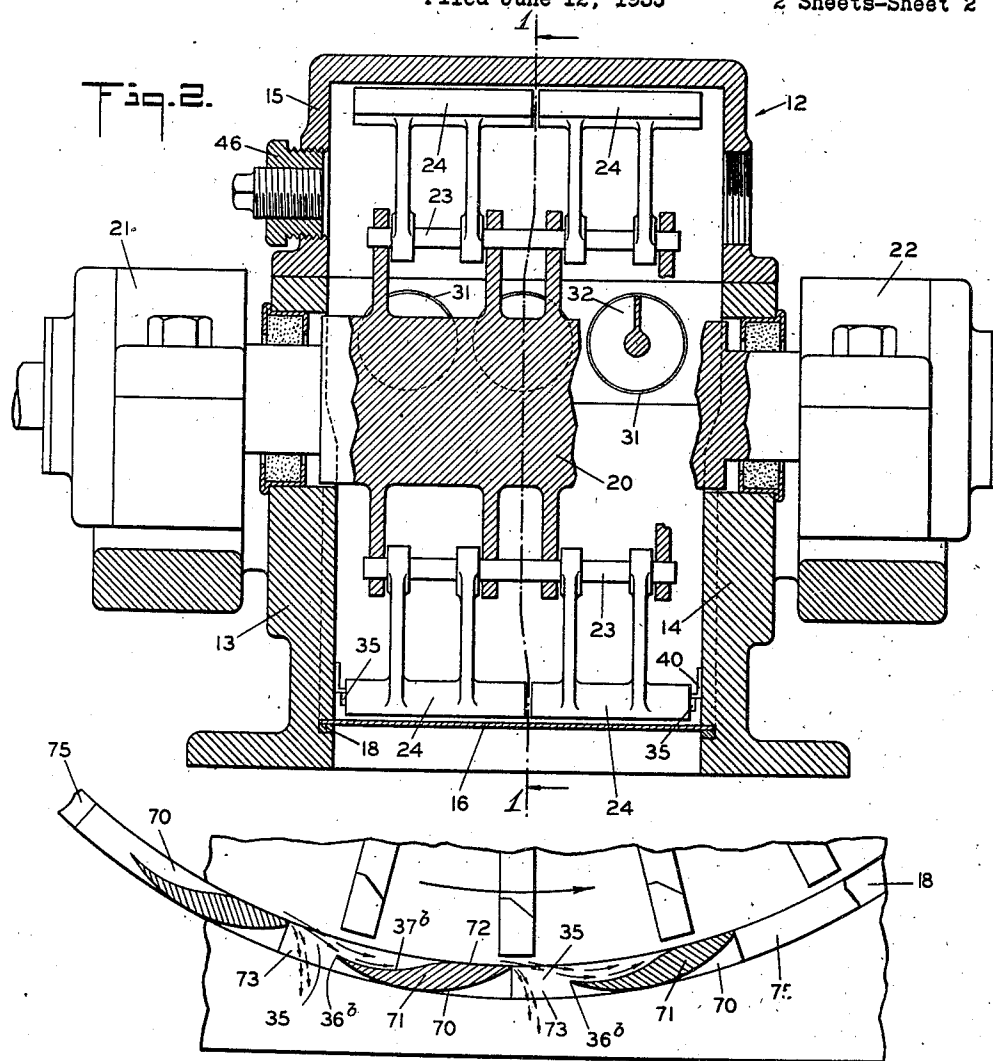
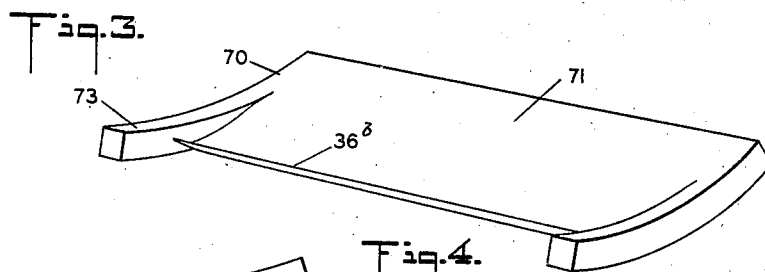
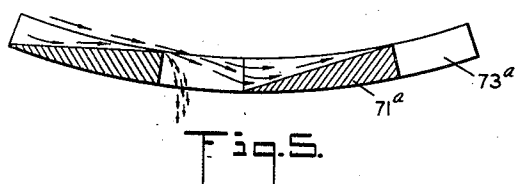
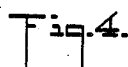
W. M. SHELDON

2,128,194

REDUCING MILL

Filed June 12, 1935

2 Sheets-Sheet 2



INVENTOR
William M. Sheldon
BY Arthur H. Kent
his ATTORNEY

UNITED STATES PATENT OFFICE

2,128,194

REDUCING MILL

William M. Sheldon, Roselle Park, N. J., assignor
to Louis Ruprecht, Montclair, N. J.

Application June 12, 1935, Serial No. 26,143

1 Claim. (Cl. 83—11)

This invention relates to material reducing mills of that type in which a high speed rotor is mounted within a cylindrical mill chamber to which the material to be treated is supplied to be reduced or dispersed by the cooperative action of peripheral parts of the rotor and portions of the peripheral wall of the mill chamber, such as the so-called hammer mills. The invention aims generally to avoid certain disadvantages of machines of this type as heretofore made and to provide such machines which have a higher efficiency and are capable of producing a finer product than machines heretofore made.

Reducing mills of the type referred to have heretofore been provided with an outlet screen forming a portion, usually a lower portion, of the peripheral wall of the mill chamber and through which the material which has been reduced to the desired degree of fineness is discharged. Such screens are usually formed by metal plates provided with a multiplicity of closely spaced perforations the size of which is a factor in determining the degree of fineness of the product, the production of finely pulverized material requiring the use of screens with comparatively small openings. Such screens, and especially those used in fine pulverizing requiring very small openings, have been the cause of much trouble and difficulty due to the clogging of the screen orifices in treating many kinds of material, resulting in interruptions in operation of the mill to clear the orifices and in increased resistance to operation of the mill and consequent increased power requirement. With some materials, on the other hand, the orifices become enlarged by abrasion, with the result that the desired fineness of product is not obtained. In addition to these difficulties, the screens must be of limited gauge thickness, so that they are relatively frail and frequently become broken and become worn by the abrasion of the material being treated and require frequent renewal.

These screen troubles and difficulties are avoided by the present invention, in accordance with which, in place of the outlet screens heretofore used, I provide in the circumferential wall of the mill chamber, and most desirably in the lower portion of the wall, one or more discharge openings, or slots, extending axially of the mill chamber, and most desirably for substantially the length of the chamber, the edge of each such discharge opening or slot toward which the material is moved by the rotation of the rotor beaters, that is, the far edge in the direction of rotation of the beaters, being spaced circumferen-

tially from and also radially outward from the near edge of the opening, and the inner surface of the chamber wall sloping gradually inward beyond each opening.

As the material being reduced is swept around against and adjacent to the peripheral wall of the mill chamber by the high speed rotor, material which is of the desired degree of fineness will pass out through such discharge opening or openings, but larger heavier particles will jump past the openings and will be deflected inward by the inclined wall surface beyond the opening to continue in their course within the mill chamber for further comminution by the action of the rotor beaters in cooperation with portions of the peripheral wall of the chamber.

The discharge of the finely pulverized material through the discharge openings is apparently due to the outward flow of air through the openings resulting from the fan action of the rotor beaters. For the particles to be carried out through the openings by the outflowing air they must be moved radially outward from their normal tangential path a distance greater than the radial distance from such tangential path of the far edge of the opening in the time taken for the particles to cross the opening. The radial acceleration which is imparted to the particles by the outflowing air current depends on the ratio between the force which the outflowing air exerts on the particles and the inertia, or mass, of the particles, the greater the force and the less the mass the greater the acceleration and resulting deflection of the particles. Since the smaller the particles the greater the force exerted by the outflowing air on each particle in proportion to its mass, the smaller particles are carried out through the opening while larger heavier particles having a smaller radial acceleration are not deflected outward sufficiently to carry them out past the far edge of the opening but jump the opening and strike the surface beyond the opening. This landing surface beyond the far edge of each opening slopes inward in the direction of rotation of the beaters so as to serve to direct these larger particles inwardly back into the path of the beaters.

By providing the mill chamber with such discharge openings, not only is the screen with its disadvantages eliminated, but a marked increase in efficiency and finer pulverization is obtained in reducing many materials; and further, it has been found possible to comminute or to disperse materials, such as oily, viscous, tacky and unctuous materials, which it has been found difficult

and sometimes impossible to treat in hammer mills having the conventional outlet screen.

A mill chamber wall provided with discharge openings according to the invention is stronger and more durable than an outlet screen, the clogging which occurs with screens is avoided, and there is a freer air outlet which lessens the building up of air pressure within the mill chamber, thereby reducing the liability to back pressure on the material inlet. This has the advantage of making possible the fine grinding or pulverizing of some materials which cannot be finely pulverized in mills provided with outlet screens, such as fluffy materials and those of very low density, and also makes practical the use of gravity feed for supplying to the mill chamber material which it has heretofore been necessary to supply by some form of force feeding.

The accompanying drawings show an illustrative embodiment of the invention in a hammer mill of known form and modifications.

In said drawings:—

Fig. 1 is a sectional view of the mill through the mill chamber on line 1—1 of Fig. 2;

Fig. 2 is a sectional view on line 2—2 of Fig. 1;

Fig. 3 is a broken sectional view illustrating a modified construction for providing outlet openings according to the invention;

Fig. 4 is a perspective view of one of the parts shown in Fig. 3;

Fig. 5 is a detail view illustrating a modification of the construction of Fig. 3; and

Fig. 6 is a detail view illustrating a modification of the construction of Figs. 1 and 2.

Referring to the drawings, and first to Figs. 1 and 2, the rotor 10 is mounted to rotate about a horizontal axis in a cylindrical mill chamber 11 within a main housing 12. End walls 13 and 14 of the housing form the end walls of the mill chamber, and the housing has a removable cover 15 which provides the upper part of the peripheral wall of the mill chamber and the end wall portions of which form the upper parts of the end walls 13 and 14. The lower portion of the peripheral wall of the mill chamber is formed by a curved sheet metal plate 16 provided with strengthening end strips 17 and side strips 18, and the plate is positioned within the housing by having its side strips 18 set in grooves 19 in the housing walls 13 and 14 in the manner customary for positioning outlet screens of mills of this general kind. The strips 18 or edges of the plate are thus in effect seated against shoulders at the housing walls. This plate 16 is formed with discharge openings as hereinafter described.

The rotor as shown comprises a heavy shaft 20 which extends across the mill chamber with its ends extending through openings in the housing walls 13 and 14 and supported outside the walls in bearings 21 and 22. The shaft is driven by the customary or any suitable means, not shown. The portion of the shaft within the chamber is provided with a plurality of axially spaced discs in which are mounted a plurality of circumferentially spaced rods 23 on which are pivotally mounted beaters 24.

The material to be treated is in the construction shown fed into the mill chamber from a hopper 30 through a plurality of feed conduits 31 by means of feed screws 32 which are driven by suitable means not shown.

The lower peripheral wall of the mill chamber, formed in the construction shown by the sheet metal plate 16, has therein one or more, two as shown, discharge openings 35 each of which extends axially of the chamber for sub-

stantially the full axial length thereof. The peripheral wall immediately beyond each discharge opening, or slot, 35 is positioned radially outward so that the far edge 36 of the opening toward which the material is moved by the beaters is spaced radially outward from the near edge of the opening, and the wall 37 beyond the opening slopes gradually inward to join the following concentric portion of the wall. Immediately beyond the edge 36 the wall may desirably slope slightly outward as shown at 38.

In the operation of the mill, as the material is swept around against and adjacent to the peripheral wall of the chamber by the rapidly moving beaters 24 the material which has been pulverized to the desired degree of fineness will, there being a suitable outward flow of air through the discharge openings 35, be discharged through the openings, but the larger heavier particles, that is, the material which is not reduced to the desired degree of fineness, will, by reason of their smaller radial deflection, jump across the opening, not being sufficiently deflected from their concentric path to pass out through the opening and will land on the sloping landing wall 37 beyond the opening.

Side plates 40 extending between concentric portions of the plate 16 and the inclined wall portions, or landing plates, 37, and lying close against the end walls 13 and 14, serve to prevent leakage of the relatively coarse material past side edges of the landing plates 37 and also serve to rigidly support the landing plates. In order to avoid having any of the coarse material which jumps a discharge slot or opening 35 strike against the edges of the plates 40 and be deflected downward into the stream of fine material being discharged through the opening, the length of the discharge opening or slot should be not greater, and should most desirably be slightly less, than the distance between the side plates 40.

The width of the discharge slot and the radial drop of the end of the landing plate, or the distance that the far edge of the slot is set radially outward from the near edge, will depend on the desired fineness of the product, and the width of the slot and the drop of the end of the landing plate for obtaining a product of any desired degree of fineness will depend on the density of the material being reduced and the peripheral speed of the beaters and the strength of the outflowing air current. In general, for any given material, the narrower the slot and the greater the radial drop of the end of the landing plate, the finer the product; and the denser the material, or the higher the peripheral speed of the beaters, the wider the slot should be and the less the drop of the end of the landing plate for a desired degree of fineness of the product; and the stronger the air flow, the narrower the slot should be and the greater the radial drop of the end of the landing plate for a desired degree of fineness of the product. The number of discharge openings most desirable will depend on the size of the mill, speed of the rotor and material to be treated, and on the dimensions of the openings as determined according to the desired fineness of the product.

For a relatively slow speed mill producing a coarse product, it is not necessary to make any special provision for the inlet of air to the mill chamber, but for fine pulverizing, and especially when the material is supplied to the mill chamber by feed screws working through feed conduits as in the construction shown, it is sometimes necessary, in order to have the desired outward

flow of air through the discharge openings, to provide the mill chamber with suitable air inlets. Such air inlets are most desirably in the end walls of the chamber, as for example, the openings 45 shown in Figs. 1 and 2. Means such as the double plug 46 are provided for partly or wholly closing one or both of these openings.

The beaters 24 are most desirably of such radial length as to provide a close clearance, for example, an eighth of an inch or less, between the outer ends of the beaters and the concentric portions of the peripheral wall of the mill chamber. As a general rule the smaller this clearance the finer will be the comminution of the material.

In some cases it is desirable to provide for adjustment of the circumferential width of the discharge openings 35 and of the radial drop of the edge 36 of the landing plates 37. Such adjustment is provided, for example, by the construction shown by Fig. 6. As here shown, the circumferential width of each of the two discharge openings shown is provided by means of a plate 60 mounted to slide circumferentially against the outer face of the plate 16 and held in desired position of adjustment by nuts 61 on bolts which extend from the plate 16 through slots in the adjustable plate 60. The radial drop of the edge 36 of each landing plate 37a is adjusted in the construction shown in this figure by means of a bell crank lever 62 connected to the landing plate by link 63 and turned by means of screw rod 64 operated by hand wheel 65. The screw rod 64 may be arranged as shown for adjusting simultaneously a plurality of landing plates.

Instead of forming the lower peripheral wall of the mill chamber or other portion of the wall provided with my discharge openings or slots of a sheet metal plate cut and stamped or otherwise formed as shown in Figs. 1 and 2, this portion of the peripheral wall of the mill chamber may be formed partly or wholly of one or more castings according to the number of discharge openings or slots. In Fig. 3 I have illustrated a construction in which three castings 70 of the form of the one shown in Fig. 4 are set into the screen grooves 18. Each casting has a body portion 71 the inner surface of which is shaped to provide an inclined landing surface 37b and a short concentric surface 72 beyond the landing surface. The extreme end portions of the casting are of a width to fill the slots 18 and are extended beyond the edge 36b of the body portion 71 to serve as spacing bars 73 to engage the adjacent casting, thus providing a discharge opening 35 in advance of the edge 36b. Suitably curved plain castings 75 may be set in the screen slots 18 in advance of the first casting 70 and beyond the last casting 70 to complete the peripheral wall of the mill chamber. As the length of the spacing bars 73 determines the

width of the discharge openings 35, the width of the openings may obviously be varied by varying the length of the spacing bars.

Fig. 5 shows another form of casting in which the body portion 71a has a flat inclined inner face, and the spacing bars 73a extend from the far edge of the body portion 71a instead of from the near edge of the body portion as shown in Figs. 3 and 4.

Reducing mills, or machines, according to the invention are adapted for reducing materials of various kinds, including hard and soft dry materials of various densities, moist and pasty materials, and materials which become gummy or melt at relatively low temperatures. While machines according to the invention are especially adapted for fine pulverization and the invention aims especially to provide a machine for producing a very finely pulverized product at a high production rate, features of the invention may advantageously be employed for relatively coarse grinding of various materials.

The terms "near edge" and "far edge" and "near side" and "far side" of the discharge openings as used in the claim are to be understood as relating to the direction of movement of the rotor beaters, the "far side" of a discharge opening being the side farthest along in the direction of movement of the beaters, and the "far edge" of the opening being the edge at the "far side" thereof, or the edge toward which the material is moved by the beaters, and the "near edge" and "near side" of the opening being respectively the edge and side opposite the "far edge" and "far side" thereof.

What is claimed is:

A machine of the class described, comprising a casing providing a cylindrical mill chamber having a material inlet opening, and a high speed rotor mounted within the chamber having a plurality of circumferentially spaced beaters, said machine having a discharge opening in the peripheral wall of the chamber extending substantially the full length of the chamber, that portion of said wall which is adjacent the near edge of the discharge opening being substantially concentric with the path of movement of the beaters, and the far edge of the discharge opening being spaced circumferentially from the near edge thereof and being spaced radially outward from the near edge thereof a distance not more than about half of the circumferential width of the opening, and the inner surface of the chamber wall sloping inward beyond the far edge of the opening at a small angle such that the particles which jump the opening and reach said surface are directed inward and forward to reenter the path of movement of the beaters.

WILLIAM M. SHELDON.